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(71) Applicant *(for all designated States except US)*: CHARMANT BEHEER B.V. [NL/NL]; Blauwborst 21, NL-5754 CZ Deurne (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: CHARMANT, Jeroen, Wilhelmus, Johannes [NL/NL]; Blauwborst 21, NL-5754 CZ Deurne (NL). BECKER, Hans, Georg [DE/DE]; Im Zirkelsrad 11-13, D-63456 Hanau (DE).

(74) Agent: VERHEES, Godefridus, Josephus, Maria; Brabants Octrooibureau, De Pinckart 54, NL-5674 CC Nuenen (NL).

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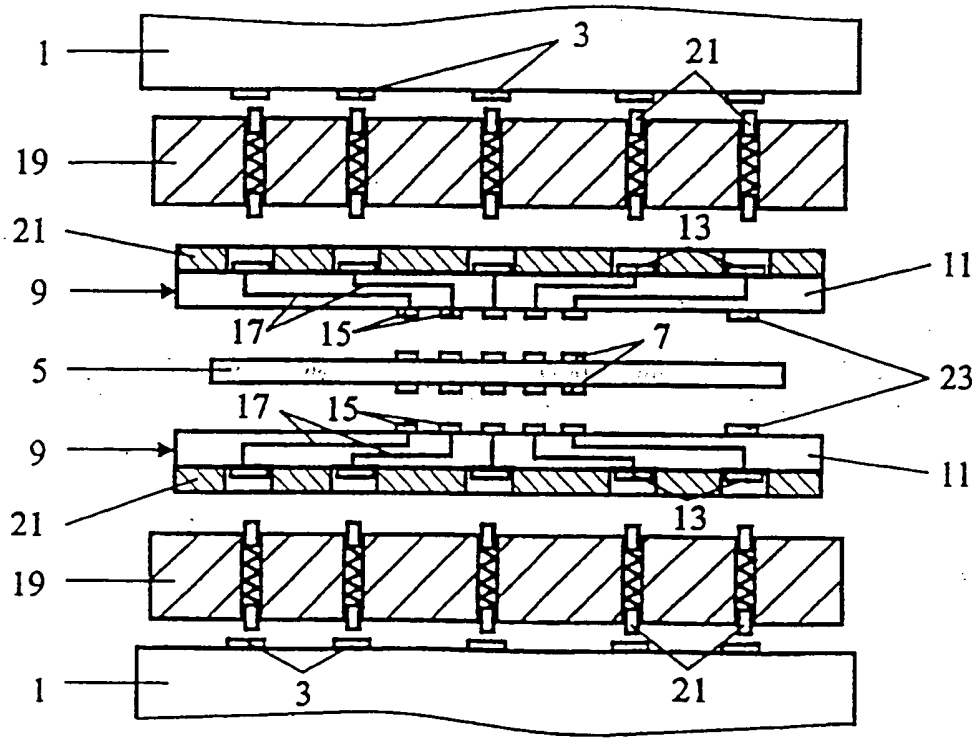
(54) Title: METHOD FOR THE MANUFACTURE OF A TEST ADAPTER AS WELL AS TEST ADAPTER AND A METHOD FOR THE TESTING OF PRINTED CIRCUIT-BOARDS

(57) Abstract

Method for the manufacture of a test adapter (9; 57) for the electrically conductive connection of measuring surfaces (3) present in a test installation (1) to test surfaces (7) present on a printed circuit-board (5) to be tested, the test adapter (9; 57) having a substrate (11; 55) with, on one side, first contact surfaces (13; 65) corresponding to the measuring surfaces (3) configuration and, on the other side, second contact surfaces (15; 67) corresponding to the test surfaces (7) configuration, whereby electrically conductive tracks (17; 63) are applied onto and through contacts (25; 69, 71) are made in the substrate (11; 55) to connect the first and second contact surfaces to one another electrically, characterised in that one or more of the electrically conductive elements, comprising the through contacts (25; 69, 71), the electrically conductive tracks (17; 63), the first contact surfaces (13; 65) and the second contact surfaces (15; 67), are applied in respectively onto the substrate (11; 55) using printing techniques.



Method for the manufacture of a test adapter as well as test adapter and a method for the testing of printed circuit-boards.

DESCRIPTION:

FIELD OF THE INVENTION

The invention concerns a method for the manufacture of a test adapter for the electrically conductive connection of measuring surfaces present in a test installation to test surfaces present on a printed circuit-board to be tested, the test adapter having a substrate with, on one side, first contact surfaces corresponding to the measuring surfaces configuration and, on the other side, second contact surfaces corresponding to the test surfaces configuration, whereby electrically conductive tracks are applied onto and through contacts are made in the substrate to connect the first and second contact surfaces to one another electrically. Such test adapters are used for measuring substrates with printed wiring, so-called printed circuit-boards (PCBs). The term PCBs includes all boards having electrically conductive tracks, irrespective of the method by which these tracks have been formed and applied, thus not only printed tracks. PCBs are used in virtually all electrical equipment. The term test surfaces refers not only to special surfaces, for example surfaces upon which components are located, but also to arbitrary locations on the electrically conductive tracks. Contact surfaces means the three-dimensional forms that are printed on a substrate, in other words these forms, as well as possessing width and length also possess height or thickness.

BACKGROUND OF THE INVENTION

Due to the continuing miniaturisation in the electronics field PCBs are becoming smaller and smaller, and the track density of the electrically conductive tracks that form the wiring is continually increasing. Before these PCBs can be used they first have to be checked for, among other things, the presence of undesired short circuits between the tracks as well as for breaks in the applied tracks. Test installations exist for the

invention is based on the view that, using printing techniques, it is indeed possible to achieve these high densities and small dimensions. The manufacture of a test adapter with such high density and small contact surface dimensions using printing techniques is entirely new. That it is not obvious that such test adapters can be made using printing techniques should be sufficiently clear from the aforementioned state of techniques in the field of test adapter manufacturing.

A further enormous advantage of the method according to the invention is that, with this method, no residues or waste are created, making it extremely environmentally friendly.

The silk screen printing technique is one method that could be used in the printing process. For preference, however, printing is carried out by placing a template on the substrate, the template having various apertures through which an electrically conductive material is applied, followed by the removal of the template. Using this template-printing technique even smaller dimensions and higher densities can be achieved than by using the silk screen printing process. A copper or silver paste can be used as an electrically conductive material.

Constructional advantages of the method according to the invention are characterised by the fact that, using the printing technique, contact surfaces can be produced on the substrate with dimensions of 100 μm or less and by the fact that, using the printing technique, contact surfaces can be produced on the substrate having a density of 30 contact surfaces per cm^2 or higher. With these small dimensions and high densities, the existing techniques for the manufacture of test adapters are too expensive to allow the testing of PCBs to be carried out at reasonable cost. The main advantage of this method is that the testing of PCBs is cost effective.

Further constructional advantages are characterised by the fact that, using the printing technique, contact surfaces are produced up to 120 μm high (thick) and by the fact that contact surfaces can be produced having an angle between the side walls and the substrate of 60° or more. Because the PCBs to be tested are never entirely flat, the test adapter substrate can never be completely flat and the contact surfaces are not all of the same height, high contact surfaces are desirable so that, during the pressing of the test adapter against the PCB under test, sufficient elastic springing of the contact surfaces is possible so as to guarantee contact of every contact surface with the measuring or test

and/or that one or more of the electrically conductive elements, comprising the electrically conductive tracks, the first contact surfaces and the second contact surfaces, are printed on the substrate.

For preference, at least a number of the contact surfaces have dimensions of 100 µm or less and a contact surface density of 30 contact surfaces per cm^2 or higher.

As already stated in the description of the method, it is also advantageous that at least a number of the contact surfaces have a height of 80 to 120 µm. Furthermore, it is also favourable that, in at least a number of the contact surfaces, the side walls are at an angle of 60° or more to the substrate, and that at least a number of the laser-drilled through holes in the substrate have dimensions of 50 µm or less and hole wall angles of 60° or more.

It is an advantage for laser drilling if the substrate material contains no glass fibres. Because the electrically conductive material should preferably be hardened at a temperature between 100 and 150°C, it is also advantageous for the substrate material to have a softening temperature of more than 150°C.

The invention also concerns a method for the testing of printed circuit-boards whereby use is made of a test adapter according to the invention, and whereby a printed circuit-board to be tested, provided with test surfaces, is placed between two parts of a test installation, provided with measuring surfaces, and whereby at least one test adapter, provided with contact surfaces, is placed between the printed circuit-board and the test installation for the electrical connection of the test surfaces with the measuring surfaces, after which both parts of the test installation are brought together and the contact surfaces make contact with the test and measuring surfaces. With the known methods for the testing of PCBs, spring elements are used to produce contact between the contact surfaces of the test adapters and the PCB measuring surfaces, mainly on or underneath the contact surfaces such as, for example, small electrically conductive springs on the contact surfaces, or contact surfaces on elastic foil with cut-outs in the substrate underneath the contact surfaces. These spring elements complicate the construction of the test adapter and, as far as miniaturisation is concerned, are unable to keep pace with the continuing miniaturisation of the PCBs to be tested. This miniaturisation of the test surfaces, and the subsequent need for the reduction in size of the test adapter contact surfaces, leads to large, and up to now, insoluble problems with regard to the construction of these spring elements.

are drilled in the substrate;

Figure 6 is a cross-section of a second constructional form of a test adapter according to the invention;

Figure 7 is a top view of a template for the application of a layer of the test adapter's track pattern; and

Figure 8 is a further stage in the method according to the invention in which electrically conductive tracks are applied.

DETAILED DESCRIPTION OF PREFERED EMBODIMENTS

Figure 1 shows a test set-up for the testing of PCBs. The test set-up contains a test installation 1, provided with measuring surfaces 3. In this example, the PCB 5 to be tested is a double-sided printed PCB with test surfaces 7 on each side. The test surfaces 7 have a different configuration to the measuring surfaces 3 and have a much greater density than the measuring surfaces. Between each side of the PCB 5 and the test installation 1 is a test adapter 9 for connecting the test surfaces 7 with the measuring surfaces 3. The test adapter 9 consists of a substrate 11 with, on one side, first contact surfaces 13 corresponding with the configuration of the measuring surfaces 3 and, on the other side, second contact surfaces 15 corresponding with the configuration of test surfaces 7. The first and second contact surfaces are connected to one another electrically via electrically conductive tracks 17. Between the test adapters 9 and the test installation 1 are units 19 with spring loaded compensation pins 21, which electrically connect the first contact surfaces 13 with the measuring surfaces 3, and take up any possible differences in height. These units 19 are needed mainly to bridge the gap between the two parts of the existing test installation 1 and the test adapters 9. The units could be discarded if working with new test installations specially designed for the new test methods. For testing, both the indicated parts of the test installation 1 are brought together whereby the second contact surfaces 15 of the test adapters 9 are pressed against the test surfaces 7. The closure force needs to be sufficiently high and uniform to ensure that all test surfaces 7 make contact with the second contact surfaces 15. This is achieved by placing pressure plates 21 between the test adapters 9 and the units 19 or, in the absence of the units, test installation 1. These pressure plates 21 need to be extremely rigid, and to this end are made, for example, from solid aluminium.

Figure 4 gives a schematic representation of the holes 35. Figure 5 shows the actual shape of one of the holes. The hole 35 is drilled in the substrate 11 using a laser beam 49. Because the laser beam 49 diverges relative to the depth that has to be drilled, the hole 35 is conical in form. The hole wall 51 of the hole 35 is therefore at an angle 53 of 75° to the substrate 11 surface. The wall 51 should be as steep as possible so that the diameter on the underside, and therefore the surface area of the through contact to be produced, is as small as possible. Steeper angles can be achieved by using a substrate 11 material that is free of glass fibres, which means that the laser beams cannot be deflected by glass fibres.

Figure 6 shows a cross-section of a second constructional form of the test adapter according to the invention. The substrate 55 of the test adapter 57 is made up of two plates 59 and 61, between which are located the electrically conductive tracks 63. On one side of the substrate 55 are the first contact surfaces 65, which correspond to the configuration of the measuring surfaces 3. On the other side are the second contact surfaces 67, which correspond with the configuration of the test surfaces 7. The contact surfaces 65 and 67 are connected to the tracks 63 via through contacts 69 and 71. The electrically conductive tracks 63 are in various layers 73 on top of one another. The space 75 between the tracks 63 in one layer is filled with insulation material. Between these layers 73 are insulation layers 77 which, in a number of places, are provided with through contacts 79. The topmost plate 61 can eventually be left out. However, in that case the through contact locations on the upper insulation layer should preferably be heightened so as to improve contact with the measuring surfaces.

The method for the manufacture of the test adapter according to the invention, showing principally the printing technique, will be described with the aid of figures 7 and 8. Firstly, holes are drilled in the substrate at the positions where the through contacts are to be located, as previously described with the aid of figure 5. After the holes have been made they are filled with, for example, a silver paste, as previously described with the aid of figure 4. Next, an electrically conductive track pattern is printed on the substrate in one or more layers. Figure 2 shows a test adapter with the tracks in one layer while figure 6 shows a test adapter with tracks in more than one layer. The tracks, and eventual through contacts in the insulation material between the tracks, are applied using a printing technique whereby an electrically conductive material is printed onto the substrate through apertures in a template.

CLAIMS:

1. Method for the manufacture of a test adapter (9; 57) for the electrically conductive connection of measuring surfaces (3) present in a test installation (1) to test surfaces (7) present on a printed circuit-board (5) to be tested, the test adapter (9; 57) having a substrate (11; 55) with, on one side, first contact surfaces (13; 65) corresponding to the measuring surfaces (3) configuration and, on the other side, second contact surfaces (15; 67) corresponding to the test surfaces (7) configuration, whereby electrically conductive tracks (17; 63) are applied onto and through contacts (25; 69, 71) are made in the substrate (11; 55) to connect the first and second contact surfaces to one another electrically, characterised in that one or more of the electrically conductive elements, comprising the through contacts (25; 69, 71), the electrically conductive tracks (17; 63), the first contact surfaces (13; 65) and the second contact surfaces (15; 67), are applied in respectively onto the substrate (11; 55) using printing techniques.

2. Method in accordance with claim 1, characterised in that the printing takes place through the placing of a template (41; 81) on the substrate (11; 87), the template having various apertures (43; 85) through which an electrically conductive material (47; 91) is applied, followed by the removal of the template.

3. Method in accordance with claim 1 or 2, characterised in that at least a number of the contact surfaces (15; 67) produced on the substrate (11; 55) using the printing technique have dimensions (27) of 100 μm or less.

4. Method in accordance with claim 1, 2 or 3, characterised in that at least a number of the contact surfaces (15; 67) produced on the substrate (11; 55) using the printing technique achieve a density of 30 contact surfaces per cm^2 and higher.

5. Method in accordance with claim 1, 2, 3 or 4, characterised in that the contact surfaces (13, 15; 65, 67) produced using the printing technique have a height (29) up to 120 μm.

6. Method in accordance with claim 1, 2, 3, 4, or 5, characterised in that the angle of slope (31) between the substrate and the side walls (33) of the contact surfaces (13, 15; 65, 67) produced using the printing technique is 60° or more.

7. Method in accordance with one of the above claims, characterised in that the through contacts (25; 69, 71) are formed by producing holes (35) in the substrate (11; 55) after which a negative pressure is applied to the first side of the substrate while, on the other

16. Test adapter in accordance with claim 11, 12, 13, 14 or 15, characterised in that at least a number of the laser-drilled holes (35) through the substrate have dimensions of 50 µm or less and the hole walls have an angle (53) of 60° or more.

17. Test adapter in accordance with claim 11, 12, 13, 14, 15 or 16, characterised in that the substrate (11; 55) is made of a material containing no glass fibres and has a softening temperature of more than 150°C.

18. Method for the testing of printed circuit-boards using a test adapter in accordance with one of the above claims and whereby a printed circuit-board (5) to be tested, provided with test surfaces (7), is placed between two parts of a test installation (1), provided with measuring surfaces (3), and whereby at least one test adapter (9; 57), provided with contact surfaces (13, 15; 65, 67), is placed between the printed circuit-board (5) and the test installation (1) for the electrical connection of the test surfaces with the measuring surfaces, after which both parts of the test installation (1) are brought together and the contact surfaces (13, 15) make contact with the test and measuring surfaces (3, 7), characterised in that a uniform pressure is applied to the test adapter (9) causing elastic deformation through which the contact surfaces (13, 15) of the test adapter (9) are brought into contact with the test surfaces (7) of the printed circuit-board (5) to be tested.

19. Method in accordance with claim 18, characterised in that a pressure plate (21) is placed between the test installation (1) and the test adapter (9) through which a uniform pressure is applied.

20. Method in accordance with claim 18 or 19, characterised in that the pressure with which the test adapter (9) is pressed against the printed circuit-board (5) to be tested is measured by at least one pressure sensor (23).

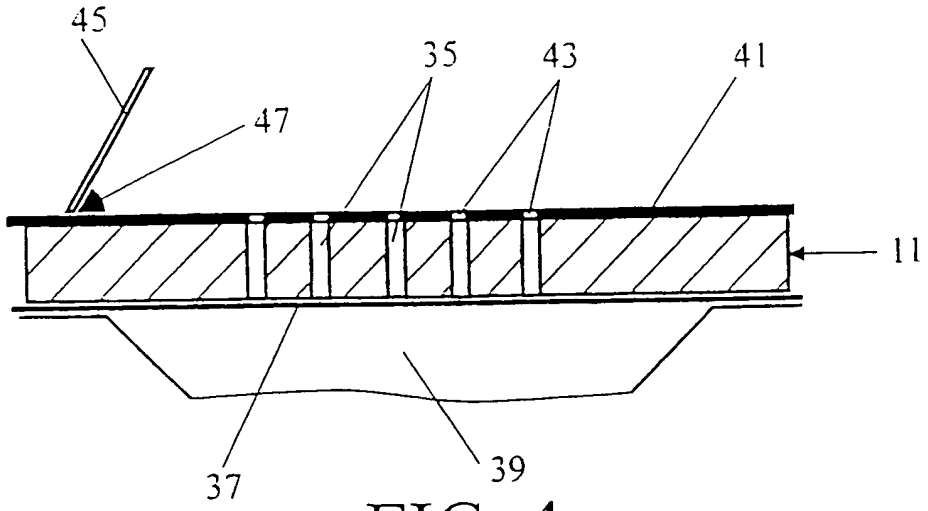


FIG. 4

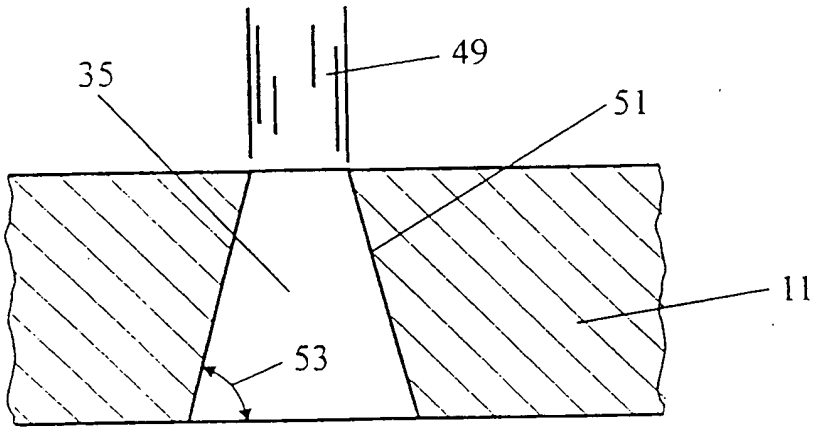


FIG. 5

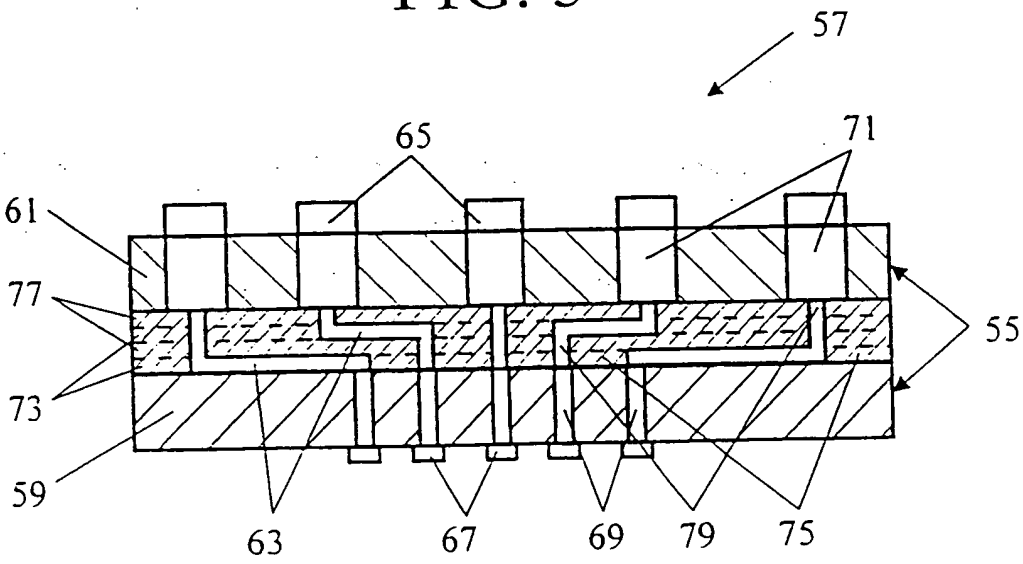


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
P /NL 97/00616

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01R3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 030 318 A (RECHE) 9 July 1991 see column 1 - column 2	1
Y	FR 2 529 406 A (LEP) 30 December 1983 see page 6	1
A	EP 0 278 484 A (ARISTO) 17 August 1988 see claim 5	1-20

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 January 1998	20/01/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Hoornaert, W

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